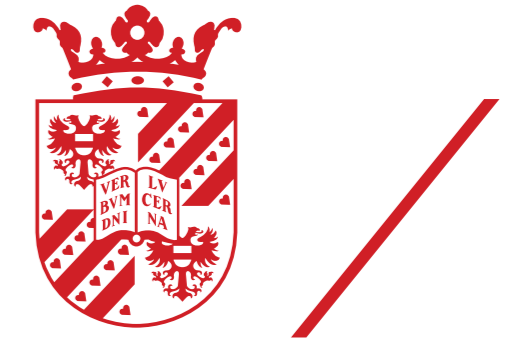




Development of a learning task for a process-oriented diagnostics of developmental speech sound disorders: a pilot study

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INTRODUCTION

Background

- Differential diagnosis and treatment planning of speech sound disorders (SSD) is one of the major bottlenecks in the field of pediatric speech-language pathology
- Intervention methods aim at specific parts of the speech production process, where diagnostic instruments consist of tests that measure knowledge and skills, and lack a direct relation with the underlying processes

Research goal

- An individualistic, process-oriented approach for the diagnosis and treatment of pediatric SSD
- Advantages
 - Direct leads for treatment - tailored to the individual speaker
 - Evaluate and adjust treatment during the evolution of the disorder

Aim of the present study

- Development and evaluation of a learning task as an instrument to assess the acquisition of sensori-motor representations of novel speech sound units

METHODOLOGY

Participants

- 6 normally developing children: 3 male, 3 female; aged 4.8-7.8 yrs
- 5 children with SSD: 2 male, 3 female; aged 4.3-7.5 yrs (Table 1)

TABLE 1: Diagnostic classification of the children with speech sound disorders.

ID	Classification	Age (y:m)	Sex	WBQ (PPVT (11))	Intelligibility (ICS (2))	Auditory discrimination (Palpa (3))		Diadochokinesis (DDK; pataka)		Oral-motor mov. assessment (iso = seq = seq fast (% correct))
						words (% correct)	nonwords (% correct)	score	judgment	
CL11	PD	5:9	m	127	4	94	100	1	2	85 - 83 - 60
CL12	PD+PAD	7:6	v	106	4	94	86	1	1	92 - 94 - 50
CL13	CAS/PD	4:11	v	115	3.86	94	86	0	4	77 - 78 - 60
CL14	PD	6:7	v	84	3.42	64	44	1	1	77 - 67 - 40
CL15	CAS/PD	4:8	m	85	4.29	56	47	1	3	58 - 33 - 30

ID	Classification	Picture naming (60 words CAI (4))				Word repetition (WR; 10 words CAI)				Non-word repetition (10 non-words similar to WR CAI)			
		PCCI	PCCCI	PSSC	atyp./typ. sub.proc.	PCCI	PCCCI	PSSC	atyp./typ. sub.proc.	PCCI	PCCCI	PSSC	atyp./typ. sub.proc.
CL11	PD	0.94	0.70	.96	3/0	.98	.50	1.00	1/0	.88	.27	.94	4/1
CL12	PD+PAD	1.00	0.96	.97	0/0	1.00	.95	1.00	0/0	.88	.95	.95	13/5
CL13	CAS/PD	0.57	0.13	.80	28/9	.48	.23	.62	23/11	.71	.27	.80	26/10
CL14	PD	0.81	0.39	.82	4/8	.69	.77	.82	5/7	.65	.50	.73	18/24
CL15	CAS/PD	0.88	0.65	.92	5/4	.91	.77	.95	0/5	.73	.09	.67	4/4

DDK-score 0 = [pataka] could not be produced; 1 = [pataka] could be produced.
DDK-judgment 0 = perfect; 1 = [pataka] in sequence in normal rate, but no acceleration; 2 = [pataka] in sequence incorrect ([l] or [k] could not be pronounced), but speeding up on two different consonants ([pa], [ta]); 3 = no fluent [pataka], not in sequence; 4 = no [pataka] production either in isolation or in a sequence of two.

Procedure (Table 2)

- Learning paradigm: repetition task of nonwords from a soundboard presented via headphones
- Stimuli: 3 non-native speech sound(-cluster)s in 4 context conditions, each item repeated 3x

TABLE 2: Schematic overview of the learning task.

Stage	Goal	Conditions		Example
		Syllable /ga/ and /ja/	Syllable-cluster /mla/	
Introduction	Explain target representation	Auditory and visual input	Auditory and visual input	
Baseline measurement		10 x attempt to produce target syllable in isolation		/ga/
Training 1	Practice target stimuli in different conditions	-Sequencing	-Sequencing	/gagaga/
		-Prosody	-Prosody	/ˈgaga/, /gaˈga/
		-Alternation following consonant	-Prosody	/gaka/, /gaxa/, /gaba/
		-Embedding	-Embedding	/gapa/, /taga/, /tagapa/
Break		Five minutes of play time		
Training 2	Repeat training stage 1	-Sequencing	-Sequencing	/gagaga/
		-Prosody	-Prosody	/ˈgaga/, /gaˈga/
		-Alternation following consonant	-Prosody	/gaka/, /gaxa/, /gaba/
		-Embedding	-Embedding	/gapa/, /taga/, /tagapa/
Endpoint measurement		10 x attempt to produce target syllable in isolation		/ga/

DATA ANALYSIS & RESULTS

Data analysis

- Consensus transcription of all utterances by two experienced speech therapists
- Dependent variables
 - Percentage consonants correct (PCC)
 - Percentage word-stress correct (PWSC; Prosody condition)

Statistics

- Repeated measures analyses of variance
- Pearsons correlations
 - ΔPCC (Training 2 - Training 1) & auditory discrimination
 - PCC & PWSC
- Case-wise comparison with Control group

FIGURE 2: Prosody condition: mean percentage consonants correct (PCC) and percentage word-stress correct (PWSC).

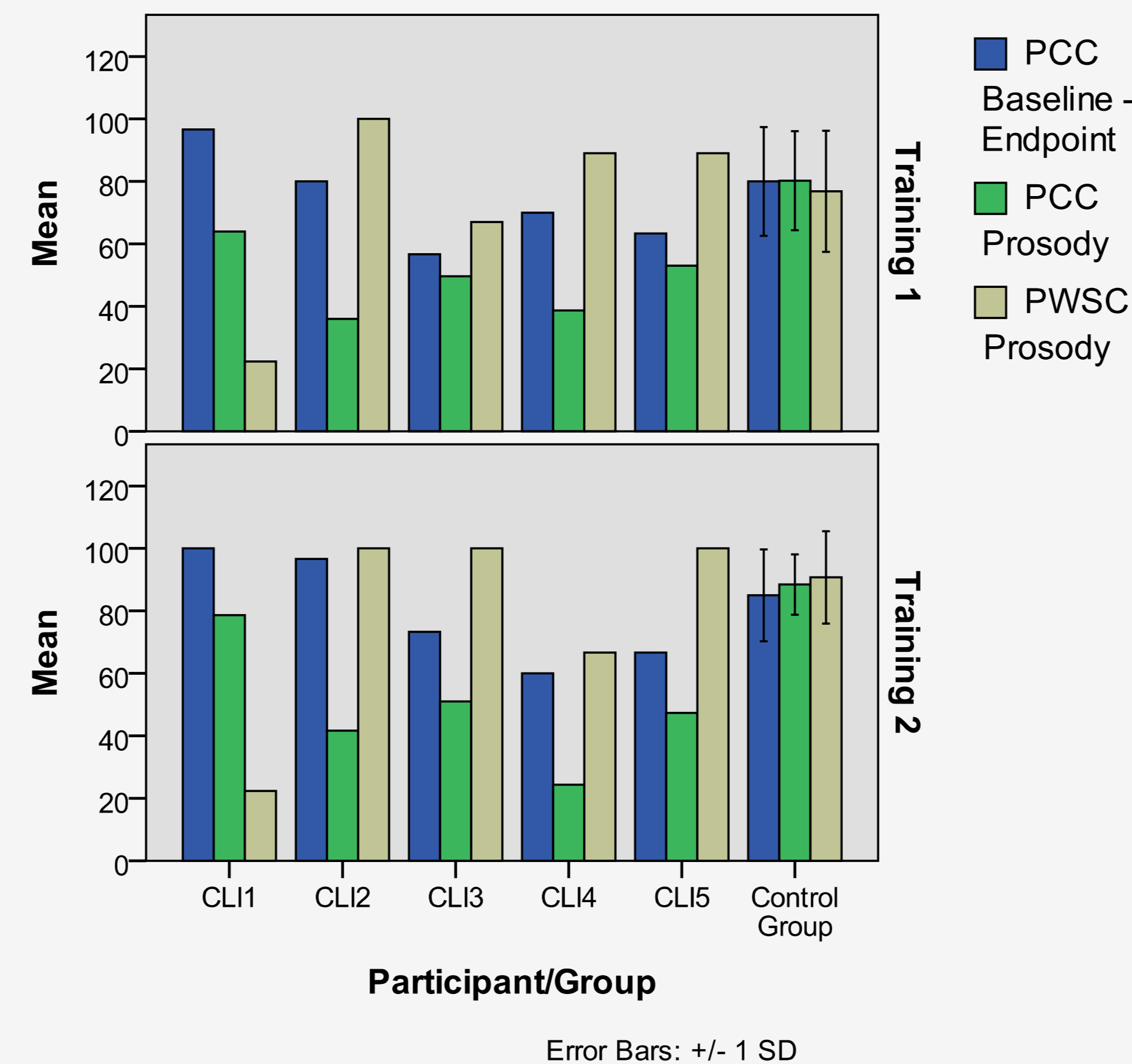


FIGURE 1: Group comparisons of mean percentage consonants correct (PCC) in the different training conditions.

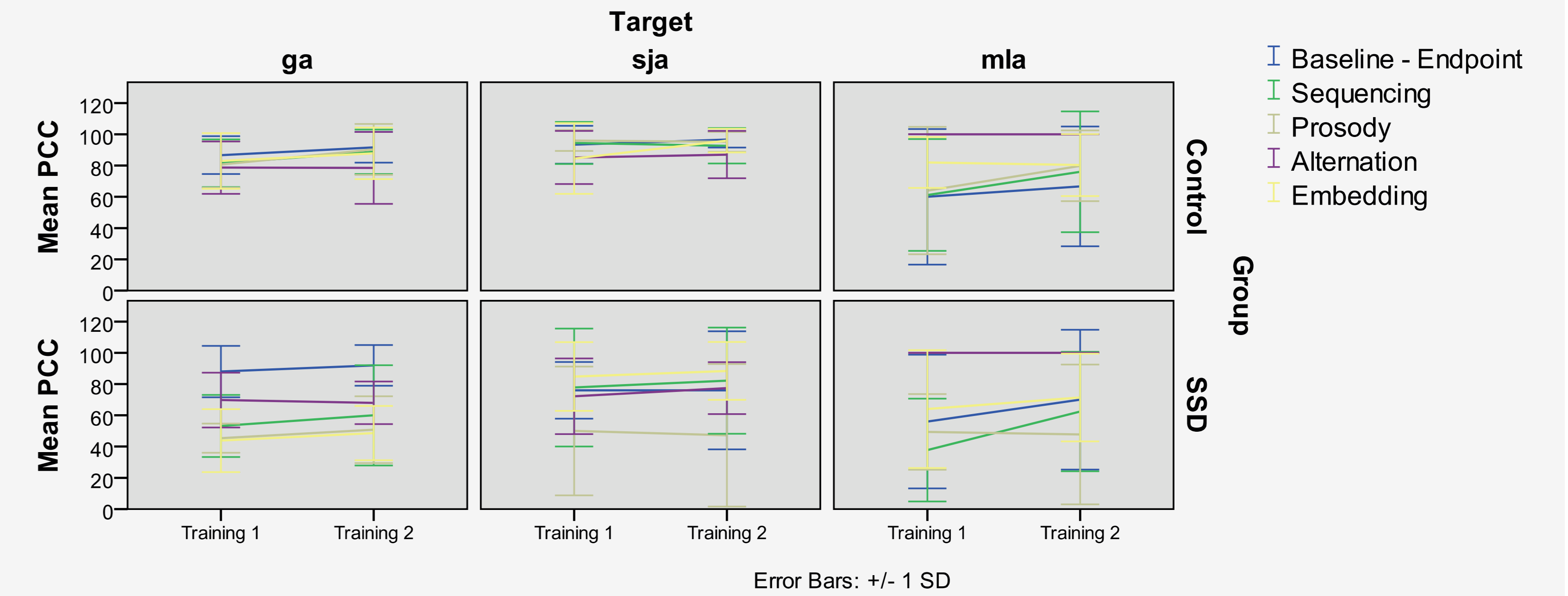


FIGURE 2: Prosody condition: mean percentage consonants correct (PCC) and percentage word-stress correct (PWSC).

Group effects

- PCC overall
 - Main effect for *ga* [F(1,9) = 12.616, p < .01]
 - Not for *mla* or *sja*
- PCC per condition
 - Prosody [F(1,9) = 20.939, p < .001]
 - Embedding [F(1,9) = 4.158, p = .072]

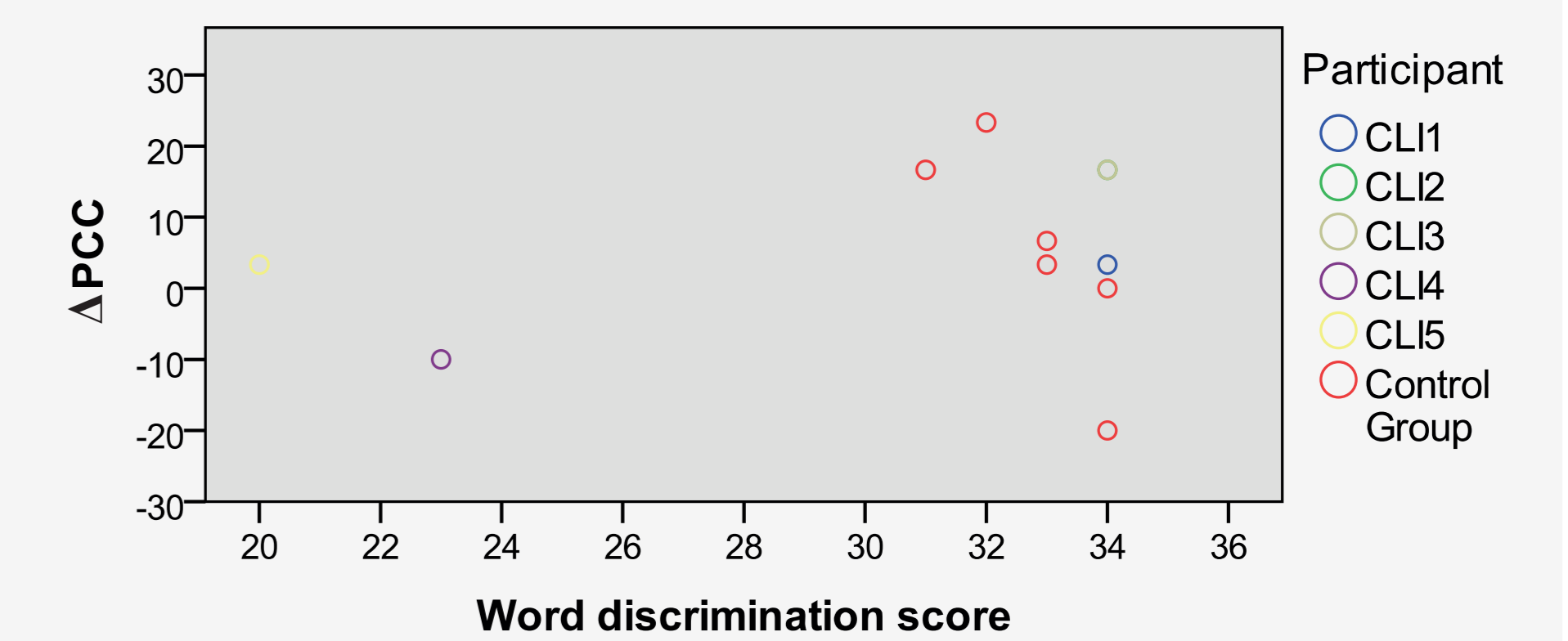
Correlations

- ΔPCC & auditory discrimination overall
 - Word discrimination & overall learning effect [r = 0.690, p < .05]
- ΔPCC & auditory discrimination per target
 - Non-word discrimination & learning effect for *ga* [r = 0.649, p < .05]
 - Word discrimination & learning effect for *ga* [r = 0.601, p = .05]
 - No significant correlations for *mla* or *sja*
- PCC & PWSC in Prosody condition
 - SSD Group [r = -0.651, p < .05]

Learning effects

- PCC overall
 - Main effect for *mla* [F(1,9) = 5.417, p < .05]
 - Not for *ga* or *sja*
- PCC per condition
 - Embedding [F(1,9) = 5.648, p < .05]
 - Sequencing [F(1,9) = 4.959, p = .053]
- PWSC: No significant effects
- No learning effect by group interactions

FIGURE 3: Overall ΔPCC vs. Word discrimination score.



DISCUSSION

- Underlying profiles vary widely per child with SSD
- Results highlight important role of perception abilities
 - Strong correlation between non-word discrimination score and learning effect
- Results highlight important role of word-stress in SSD
 - Higher PCC in the prosody condition for *ga* and *sja* in SSD vs controls
 - Negative correlation between PCC and PWSC in the prosody condition
 - Detailed analysis of the individual data
 - * 2 cases: trade-off between accuracy at the segmental and supra-segmental levels

Future directions

- More data needed!
- Promising results for the profiling of SSD, suggesting that a detailed assessment of the acquisition of novel sensori-motor representations could provide direct starting points for therapy planning
- Focus assessment on Embedding, Sequencing & Prosody

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